



in partnership with The Kendeda Building for
Innovative Sustainable Design

Unit Introduction

Grade Level/Band: 6

Summary

The Kendeda Building for Innovative Sustainable Design is the first building in Georgia and 28th in the world to earn Living Building Challenge (LBC) certification, the world's most ambitious and holistic green building achievement. With a goal to be regenerative, the building aims to have a positive impact for the environment and the community.

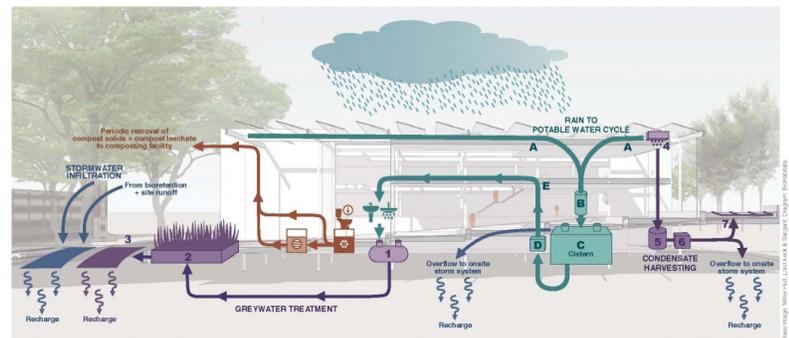
The Living Building Challenge uses the metaphor of a flower and its regenerative properties. The Kendeda Building meets the 7 performance based criteria, called "Petals" including; Place, Water, Energy, Health and Happiness, Materials, Equity, and Beauty. The Water Petal focuses on how the building site manages the hydrological flow and consumes water.

NET POSITIVE WATER CYCLE – LIVING BUILDING CHALLENGE STRATEGY

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| <p>GREY WATER TREATMENT</p> <ol style="list-style-type: none"> 1 Primary treatment tank—collects, settles*, digests 2 Constructed wetlands—passive ecological polishing 3 Subsurface infiltration—recharges groundwater | <p>RAIN TO POTABLE WATER CYCLE</p> <ol style="list-style-type: none"> A Rainwater collection—piping B Inlet Filtration from roof C Basement cistern D Potable water filtration + UV disinfection skid E Distribution to potable fixtures | <p>COMPOSTING TOILET CYCLE</p> <ol style="list-style-type: none"> 1 Foam flush toilet fixtures (compatible with composting unit) 2 Composting unit (serve multiple toilets) 3 Compost leachate storage tank <p><small>*Periodic outside removal to bioactive composting facility</small></p> | <p>CONDENSATE HARVESTING</p> <ol style="list-style-type: none"> 4 Condensate from building cooling system 5 Condensate storage tank 6 Filtration + irrigation pump 7 Site irrigation system |
|---|--|--|--|

Living Buildings are only allowed to have minimal stormwater runoff. The site on which The Kendeda Building was built used to be a parking lot. When rain falls onto a parking lot, it immediately gets turned into stormwater. This stormwater picks up all the soot, dirt, and pollution on the parking lot and dumps it into the sewers. This water eventually ends up in our streams, creeks, rivers, and lakes.

This sixth grade lesson will study how the building's design manages stormwater by emulating the Piedmont Forest ecosystem, which is the ecosystem of our metro Atlanta region.

Like the canopy of a forest, The Kendeda Building's solar array, roof deck, and green roof slow down the rainfall. The solar array and roof deck collect about 41% of the water, filtering and storing it in the 50,000 gallon cistern in the building that will ultimately supply the drinking, sink, and shower water demands for the building. The remaining 59% of rainwater is slowly released into the ground through seepage areas, rain gardens and permeable pavers.

NOTE: As of the writing of this lesson plan, The Kendeda Building's rainwater-to-drinking water system has not received final regulatory approval to become operational. The delay is the result of COVID forcing both Georgia Tech staff and the state regulator to focus on the pandemic. However, the plan is for the system to eventually provide occupants of the building with all of their potable water for drinking, sinks, and showers.



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Background and Preparation

Background Knowledge

Students should have background knowledge of the hydrologic/water cycle including infiltration and groundwater.

At the end of this lesson, students:

- Will be able to identify the basic characteristics of stormwater and the effects it can have on different surfaces.
- Will recognize the differences between permeable and impermeable surfaces relating to stormwater runoff.
- Will make observations in their community of stormwater runoff.
- Will be able to design a solution for the stormwater runoff.

Time Required:

This unit will take 10 -12 one-hour class periods (can be adapted depending on how much time you provide students for the group project).

Key Vocabulary

Stormwater: precipitation (rain) produced by a storm that hits the ground or buildings.

Runoff: generated from rain and snowmelt that flows over land or impervious surfaces, such as paved streets, parking lots, and building rooftops, and does not soak into the ground.

Groundwater: stormwater that soaks into pervious surfaces (fields, forests, wetlands) and provides water to our streams, rivers, creeks and lakes.

Permeable: material that allows liquid or gas to pass through.

Impermeable: material that does not allow liquid or gas to pass through.



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Standards and Essential Questions

| | |
|--|---|
| Next Generation Science Standards | MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. |
| Georgia Standards of Excellence | <p>Priority Standard: S6E6. Obtain, evaluate, and communicate information about the uses and conservation of various natural resources and how they impact the Earth.</p> <p>Supporting Standard: b. Design and evaluate solutions for sustaining the quality and supply of natural resources such as water, soil, and air.</p> |
| Essential Questions | <ul style="list-style-type: none"> •What is stormwater? •Why is it important to learn about stormwater? •Where does stormwater go? |

Full Lesson Plan and Student Sheets Accessed from Slow the Flow Lesson Plan.



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5E Model Lesson Overview

Engage

Students will watch two videos taken during a storm at the Kendeda building. Students will participate in a group discussion of the video and focus on stormwater. Working in pairs, students will complete a phenomenon observation. The teams should discuss their observation and draw a diagram highlighting important information about what they observed (water flow, standing water).

Explore

- Students will learn about the Living Building and break down the different ideas related to the Water Petal. They will learn more details through videos produced by Kendeda Building. Resources:Kendeda Living Building: Water Petal, Kendeda Living Building Water
- In teams, students should explore how different surface material affects stormwater runoff. They will build a contained drip system using recycled materials. Students will then develop a method to test the differences or similarities of concrete, gravel, sand, or soil. Students will collect data and discuss observations.

Explain

- Students will review the results from their stormwater runoff lab in their groups. They will discuss how they can act out how each of the materials responded to the stormwater runoff without any talking. Students will then draw their ideas in their lab notebooks. Each group will have a turn to demonstrate. Tableau Activity
- Students should observe and make connections between the flow of water and the materials used. Further discussing the difference between permeable and impermeable materials. Students will be able to create models from the lab to demonstrate how the different materials responded to the water.
- Students will create a graphic recording of permeable vs. impermeable using examples from the stormwater runoff lab.
- Students will use the knowledge they gained in the stormwater lab to research all the ways the Kendeda Living Building manages stormwater to prevent runoff. They will then create a presentation to explain at least 3 of the methods the Kendeda Living Building applies to stormwater runoff.



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Elaborate

Slow the Flow Project

Students will design a solution to a stormwater runoff issue in their community. Students can create models, 3D interactive models (such as tinkercad), videos, etc., to design a solution by using methods they learned about as they researched the methods the Kendeda Living Building uses to mitigate stormwater runoff on-site. Showing their progression of ideas, students will explain why they chose their method(s) specific to the problems they observed in their area. Students' projects should be presented and discussed.

Evaluate

During the lab and research phase, the teacher will conduct ongoing formative assessments to check on the progress of student understanding. During the Extend activity, the teacher will evaluate the student's final design.

Credit & Copyright Information

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Engage

6th Grade Phenomenon Observation

This is an introduction to Stormwater runoff. The teacher will show two short videos, and students will take notes on their observations. Students will work in groups to share ideas.

Materials Needed

- Phenomenon Observation Sheet (copies for each student)
- Poster paper/whiteboard/post-it notes

Time Frame

40 - 50 minutes

Teacher Prep

Have videos ready to play before students arrive. Have poster paper (if using) placed around the room with the following questions as a header. "What is Stormwater", "Why is it important to learn about stormwater", and "Where does stormwater go?". If teaching multiple classes, either take down the previous class's poster paper or cover their answers before the next class comes in.

Procedure

1. Have students leave their answers to each question. Place students in groups and have them brainstorm answers together for each of the questions. Once each group has had a chance to answer each question you can review the different answers and a class to discuss.
2. List key vocabulary terms on the board so students can reference them later.

Stormwater: precipitation (rain) produced by a storm that hits the ground or buildings.

Runoff: generated from rain and snowmelt that flows over land or impervious surfaces, such as paved streets, parking lots, and building rooftops, and does not soak into the ground

Groundwater: stormwater that soaks into pervious surfaces (fields, forests, wetlands) and provides water to our streams, rivers, creeks, and lakes.

3. Show the videos: [Video 1](#), [Video 2](#)
4. Have the class discuss the different observations, differences, and similarities between the two videos. Ask students what else they would like to learn more about.
5. Working in groups have students fill out the Phenomenon Observation (found below). After completing, have groups share out observations. Discuss different observations and questions students might have.

Engage ////////////////////////////////////

Phenomenon Observation

Name: _____

Date: _____

After watching the two videos please complete the following chart.

| | Video 1 | Video 2 |
|---|---------|---------|
| What did you observe? (List) | | |
| Draw a diagram. | | |
| Give a brief description. | | |
| What questions do you have about what you observed? | | |
| What would you like to learn more about? | | |



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Explore

6th Grade Stormwater Runoff Lab

Students will conduct an experiment in which they will explore how different surface materials can affect the amount of stormwater runoff. After creating the lab set up, students will design and conduct an experiment comparing the rate of stormwater runoff on the different surface materials. This activity provides students with a better understanding of the effects permeable and impermeable materials have on runoff. It also illustrates how engineers might design areas utilizing runoff prevention practices.

Materials Needed

- 4 Plastic bottles (8-ounce sturdy)
- 4 Beakers/cups
- Gravel
- Soil Sample
- Water
- Plant and organic material (succulents work)
- Box with hinged lid
- Paper towels
- Plastic trash bag/butcher paper
- Timer
- Utility knife or x-acto knife
- Quick setting concrete
- Plastic container for mixing
- Water



Time Frame

4 to 6 one-hour-long class periods depending on how quickly students are able to complete the lab.

Teacher Prep

Make sure each lab group has the needed materials. The teacher will need to cut the water bottles before lab and mix quickcrete.



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Procedure

Day 1: Prepare Model

1. Gather your materials. Make sure to have a clear workspace. Cover your workspace with trashbag or butcher paper to protect it from water spilling.
2. Prepare Model #1- Quickcrete by covering the plastic bottle with a layer of the quickcrete. The bottle should be about halfway full, laying on its side. Allow to dry for about 10 minutes.
3. Prepare Model #2- Place grass/sod in the next plastic bottle
4. Prepare Model #3- Place a layer of sand and then a layer of gravel in the next plastic bottle
5. Prepare Model #4- Gather a soil sample (red Georgia clay or soil found locally) and place it in the next plastic bottle
6. Prepare Model #5- Place the plant and organic material in the last plastic bottle.
7. Once all the bottles have been assembled, place them at a downward angle and secure them in the shoe box. The caps of the water bottles should be below the bottom of the bottle.





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Day 2: Run Experiment

1. Now that they have created the models, the students must set up their science journal or lab notes. Students need to create a table that will allow them to collect the data. Some things to consider: source, day, time, amount of water input and output, observations. Encourage students to think about what questions they would like to answer while running the lab. Remind students that they are investigating the effects different surface materials have on stormwater runoff.
2. Once data collection page is organized have students start the experiment.
3. Place plastic cup or beaker at the opening of the bottle
4. To run the experiment measure 200 mL of water in your beaker.
5. Pour the water on the far end of the bottle so that it flows downhill towards the opening and into the container.
6. After 2 minutes, measure the amount of surface runoff for each model and record the data in your lab report or science journal. Have students think about the best way to calculate the water that is collected. Volume or weight? How should debris be filtered out? Make sure that students consider the best way the experiment can be repeated by anyone.
7. Repeat steps 3 - 6 for each of the 5 surfaces.
8. Once data has been collected, have students analyze the data. Ask students to share their findings, specifically how the different surface materials affected the runoff. What was the variation between the materials, and how could this research be useful? What other observation did you make that would lead you to further investigations?
9. Extensions: Repeat the investigation at 15 degree angle, 30 degree angle





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Explain

6th Grade Stormwater Runoff Lab

Students will use their background knowledge along with their results from the lab to help them explain.

Materials Needed

- Copies of [Tableau Activity](#)
- Copies of [Graphic Recording](#)

Time Frame

1 to 2 one-hour-long class periods.

Teacher Prep

Have access to computers or copies of the handouts.

Procedure

Activity 1: “With what you know now about stormwater, what are some factors that might change the rate of runoff in different environments?”

- 1) Have students review the results from their stormwater runoff lab in their groups.
- 2) Gently guide them to discuss their observations and how they can act out how each of the materials responded to the stormwater runoff without any talking. Further discussing the differences in permeable and impermeable materials.
- 3) Students can draw their ideas in their lab notebooks.
- 4) Once they have had a chance to practice have each group demonstrate in front of the class.

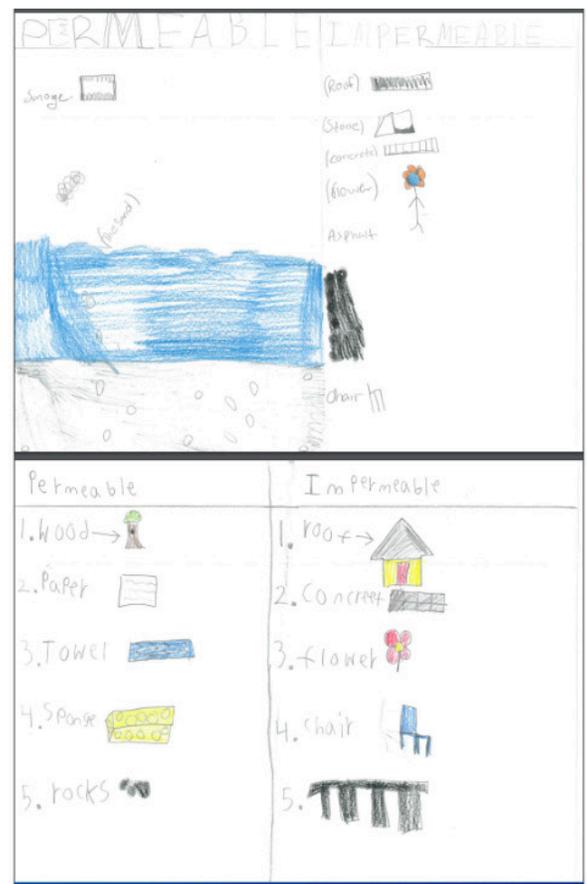


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Procedure

Activity 2: "What Factors affect stormwater runoff?"

- 1) To follow up and further synthesize students will create a graphic recording of the knowledge they gained about permeable and impermeable materials.
- 2) Have students share their recordings with the class. Guiding them to discuss how stormwater runoff and how it impacts water quality is an important topic to discuss. Allow them to use their new knowledge about stormwater runoff to draw connections to the water cycle.





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Extend and Evaluate

6th Grade Solutions to sustain the quality of water supply.

In this lesson students will research all the ways the Kendeda Living Building manages stormwater to prevent runoff. Students will consider their own community needs and utilize that information to design a plan that would apply similar methods to stormwater runoff. Students will create a presentation to share at least 3 of the methods they learned about the Kendeda Living Building and present their plan for their own community stormwater run off solutions. Teachers will give students a choice of presentation methods depending upon the resources available. Some presentation ideas include; Google slides presentation, video, Prezi, Netflix template, Brainpop video, poster, digital poster.

Materials Needed

- Computer
- [Kendeda Living Building: Water Petal](#)
- [Kendeda Living Building Water](#)

Time Frame

1 to 3 one-hour-long class periods.

Teacher Prep

Have access to computers or copies of the handouts. Ipad or cameras to take photos, tinkercad or another application to create a model.



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Procedure

1. Now that students have a basic understanding stormwater runoff and its impacts they will brainstorm where they have see stormwater runoff in their own community.
2. The task is to research the ways the Kendeda Living Building manages stormwater to prevent runoff and apply those strategies to design a solution for an area in your community that is affected by stormwater runoff.
3. Have students make observations around your school or your neighborhood and look for evidence of human environmental impact in the form of stormwater runoff. It is suggested you have students take notes and leave observations in their science notebooks or journals. Additionally students should take videos and/or pictures of the area (while it's raining would be best).
4. Create a model to SLOW the FLOW of Stormwater Runoff. Have students create a model, Tinkercad model, video, or another pre approved presentation. 4) Create a model to SLOW the FLOW of Stormwater Runoff. Have students create a model, Tinkercad model, video, or another pre approved presentation.
5. Students presentation MUST include;
 - At least three strategies the ways the Kendeda Living Building manages stormwater to prevent runoff
 - Pictures/video of affected area in your community or around school
 - Observations
 - Model to "Slow the Flow"
 - Reasoning why you chose the specific method
6. After presentations, have students give each other feedback any way you choose.

Possible Rubrics for Presentation

- [Buck Institute Presentation Rubric](#)
- [Reding Buck Institute Creativity and Innovation Rubric](#)
- [Thinking Rubric](#)